Minimal presurgical orthodontics for a skeletal Class III patient with mandibular asymmetry

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A 19-year-old man with a skeletal Class III malocclusion was treated using minimal presurgical orthodontics. Orthodontic appliances and miniscrews were placed at the beginning of treatment, and the double-jaw-surgery was performed once the maxillary right and left first premolars were intruded, without worsening the concave profile and facial asymmetry presurgically. Different from the traditional combined orthodontic-orthognathic surgery, the jaw discrepancy was corrected first, followed by the orthodontic tooth movement. Miniscrews were used to intrude the premolars presurgically because of their interference and to provide the skeletal anchorage for intermaxillary elastics after the operation. The patient was pleased with the treatment results and satisfied with his facial and dental appearance, as well as his oral function. The 1-year follow-up photographs show a stable result both esthetically and functionally. (Am J Orthod Dentofacial Orthop 2016;149:99-113)

Patients with a skeletal Class III malocclusion always complain of an unharmonious profile and poor biting of their occlusion. Most of them are more concerned with their unpleasing dental and facial appearances than with a functional deficiency.[1] It is well documented that these patients typically suffer from low confidence and even self-contempt, which affects their mental and social well-being.[1-5]

Traditionally, combined orthodontic-orthognathic surgery was performed for patients with a severe Class III malocclusion, sequenced by presurgical orthodontics, orthognathic surgery, and postsurgical orthodontic treatment.[6-8] However, aligning and leveling during preoperative treatment is a time-consuming process, and patients are subjected to progressive deterioration of their facial appearance and function caused by decompensation of the maxillary and mandibular anterior teeth.[3]

To address the patients' chief complaint, a surgery-first approach, involving surgical-orthodontic treatment without preoperative orthodontic treatment, was proposed.[9] The surgery-first approach changes the facial appearance at the beginning but also increases the risk of relapse because of the lack of a relatively stable occlusion.[10] It has been demonstrated that a stable occlusion is one of the most important factors for preventing postoperative relapse.

Considering these advantages and disadvantages, minimal presurgical orthodontics (0-6 months) has been proposed to eliminate the postsurgical occlusive interference and to produce a relatively stable postoperative occlusion.[11] The treatment details vary among individual institutes.

In this article, we report on a comprehensive surgical-orthodontic treatment with minimal presurgical orthodontics for a skeletal Class III adult with mandibular asymmetry. Miniscrews were used as skeletal anchorage to correct minor surgical interferences to prevent relapse tendencies after the jaw operation.

DIAGNOSIS AND ETIOLOGY

A 19-year-old man came with chief complaints of underbite and facial asymmetry. His medical and dental histories were not significant, but his mother had a protrusive mandible without an anterior crossbite. Heredity was considered one factor in the cause of the patient's malocclusion.[12]

The facial photographs showed a maxillary deficiency and severe mandibular protrusion with an unesthetic smile (Fig 1). In the frontal view, the lower third of the face was elongated with the chin shifted to the right

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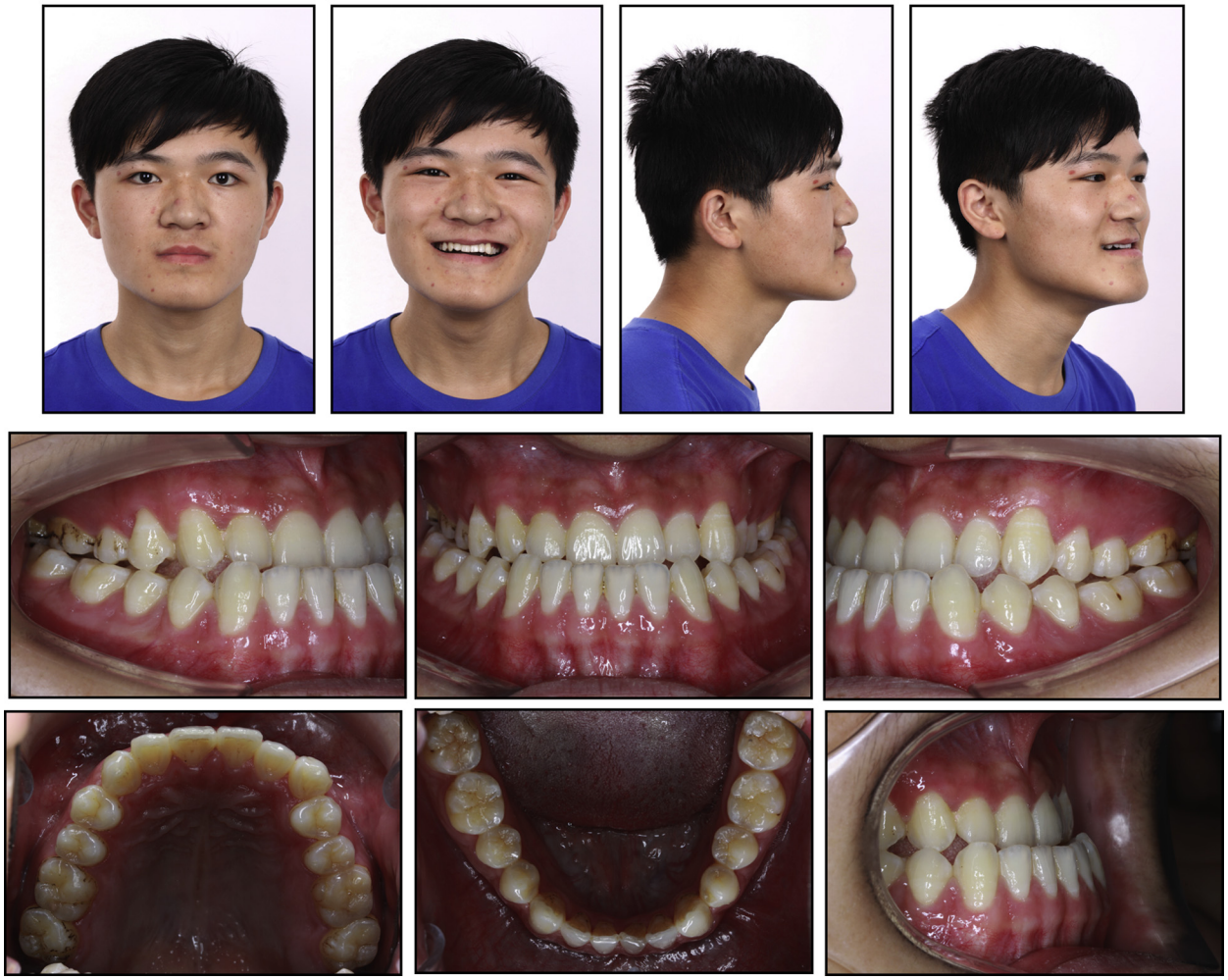

Fig 1. Pretreatment facial and intraoral photographs.

by 4 mm. The nasolabial angle and the mentolabial sulcus were unattractive.

The intraoral examination of the molar relationships showed full Class III on the left side and cusp-to-cusp Class III on the right side (Figs 1 and 2). The mandibular midline deviated 2 mm toward the right. Mild crowding in both arches and an anterior and transverse bilateral crossbite with a negative overjet (−4 mm) were evident. Extrusion of the maxillary first premolars was observed. There were no obvious clinical symptoms or signs in the temporomandibular joint examination.

The lateral cephalometric analysis indicated a skeletal Class III relationship with a decreased ANB angle of −9.01° (Fig 3; Table I). Compensating for the Class III skeletal pattern, the maxillary incisors were proclined, and the mandibular incisors were retroclined. A posteroanterior radiograph showed mandibular asymmetry, with the chin deviated to the right. The panoramic film and regional cone-beam computed tomography image suggested no pathologic changes of the temporomandibular joint.

TREATMENT OBJECTIVES

Because the patient was eager to alter his facial appearance without experiencing progressive deterioration, we proposed a minimal presurgical orthodontic treatment. In terms of facial esthetics, the objectives were to (1) improve upper lip projection and paranasal support, (2) reduce the lower facial height, and (3) and create a straight profile. The overall objectives aimed at function and stability, in addition to esthetics, were to (1) eliminate any prominent occlusal interferences

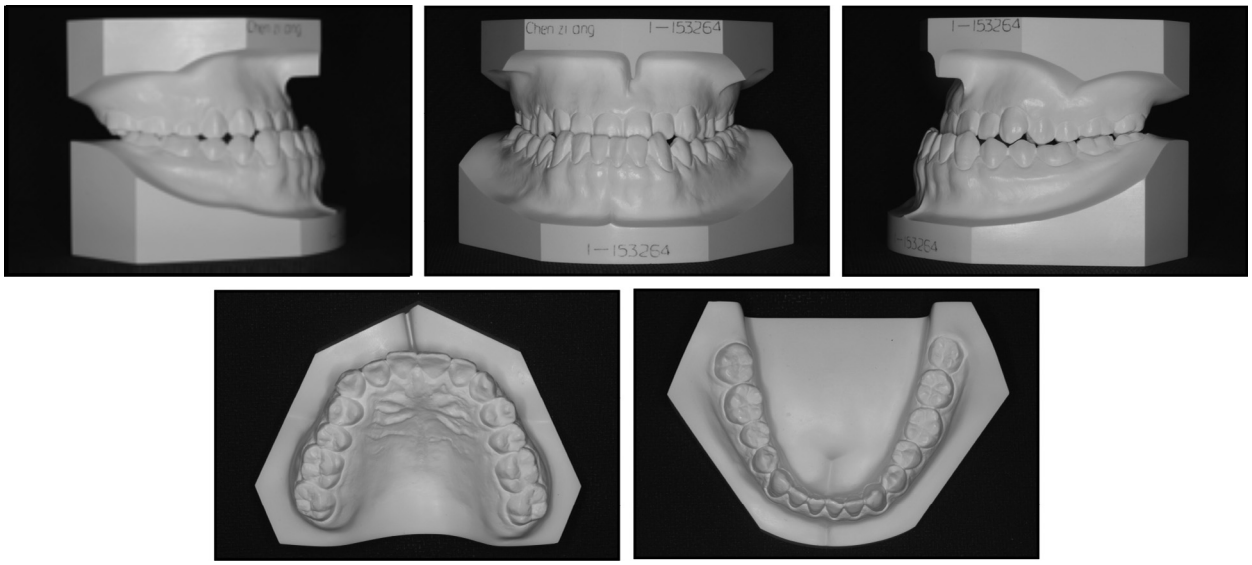

Fig 2. Pretreatment study casts.

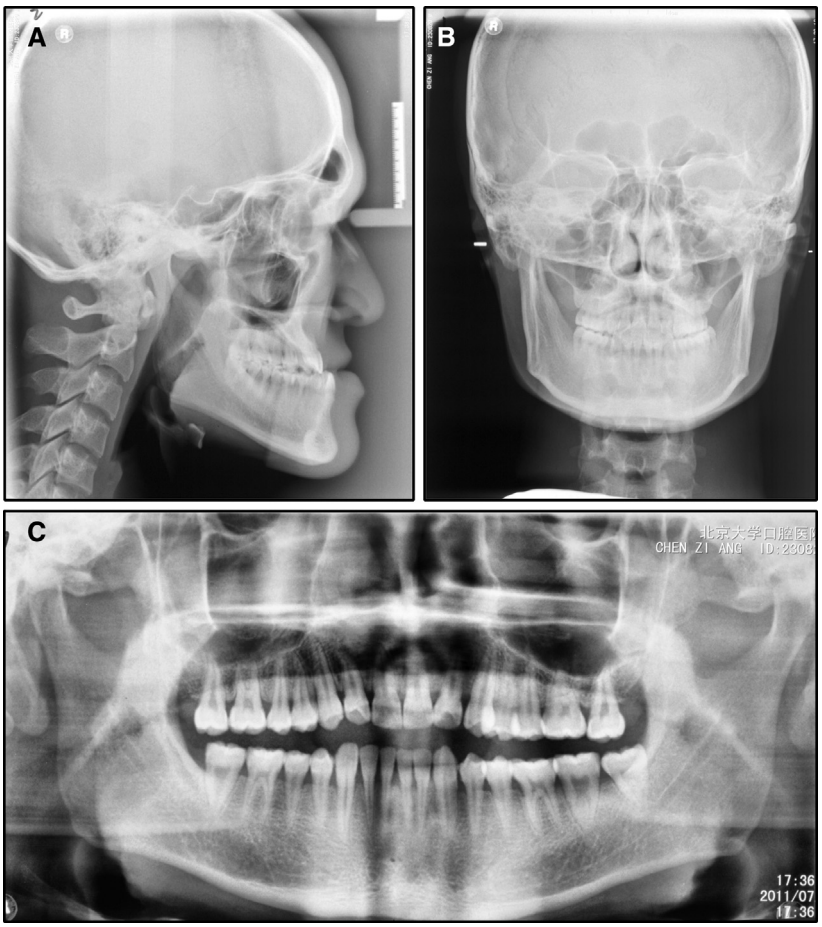

Fig 3. Pretreatment radiographs: **A,** lateral cephalogram; **B,** posteroanterior radiograph; **C,** panoramic radiograph.

Table I. Cephalometric analysis at pretreatment and posttreatment

Measurement	*Norm*	*Pretreatment*	*Posttreatment*
SNA (°)	82.80 ± 4.00	81.04	83.71
SNB (°)	80.10 ± 3.90	90.71	82.86
ANB (°)	2.70 ± 2.00	−9.67	0.85
FH-NP (mm)	85.40 ± 3.70	98.02	88.32
NA/PA (°)	6.00 ± 4.40	−23.70	−8.87
U1-NA (mm)	3.50 ± 6.50	8.80	6.24
U1/NA (°)	22.80 ± 5.70	36.57	33.02
L1-NB (mm)	6.70 ± 2.10	0.26	4.56
L1/NB (°)	30.50 ± 5.80	2.22	15.39
U1/L1 (°)	124.20 ± 8.20	150.88	130.75
U1/SN (°)	105.70 ± 6.30	117.61	116.73
MP/SN (°)	32.50 ± 5.20	25.22	24.78
MP/FH (°)	31.10 ± 5.60	19.85	24.48
L1/MP (°)	93.90 ± 6.20	66.29	87.75
Y (°)	66.30 ± 7.10	56.42	64.22
Pg-NB (mm)	1.00 ± 1.50	4.00	10.43

before surgery, (2) advance the maxilla, (3) set the mandible back and correct facial asymmetry simultaneously, (4) level and align both the maxillary and mandibular dentitions, (5) relieve the compensation, (6) and establish a Class I molar and canine relationship with ideal overjet and overbite.

TREATMENT ALTERNATIVES

According to the treatment objectives, the treatment alternatives proposed to the patient were the following.

1. Camouflage treatment was possible to correct the dental anteroposterior discrepancy by maximizing the maxillary and mandibular dentoalveolar compensation. This protocol could involve extracting the mandibular third molars to permit uprighting the posterior teeth and retracting the anterior teeth. Miniscrews in the retromolar region might be considered to further distalize the entire mandibular dentition. Although the risk and cost of this option were lower, the patient's main concern about esthetic improvement would not be addressed.[13] Moreover, for a severe skeletal malocclusion, the outcome with compensating treatment would be unstable.[13,14]
2. Routinely combined surgical and orthodontic treatment with maxillary advancement and mandibular setback was proposed to obtain the overall objectives. However, the patient would experience progressive deterioration of his facial appearance during the leveling, aligning, decompensating, and space-closing stages before surgery could be carried out. This could have negative effects on his psychological well-being.
3. In the surgery-first approach, no active presurgical orthodontic alignment would be performed. The patient would have surgery to correct the skeletal discrepancy at the beginning, without degrading his facial appearance. However, there could be instability, and the outcome would be unpredictable.
4. Minimal presurgical orthodontic treatment with the aid of miniscrews was proposed to eliminate the obvious occlusal interferences on the study model, decrease the instability of the postsurgical occlusion, and increase the predictability of the surgical results.[11] Most of the orthodontic treatment, including aligning, leveling, decompensating, space closing, and detailing, would be done postoperatively.

Informed of the positive and negative reasons of these treatment alternatives (Table II), the patient chose the fourth option because he wanted his facial appearance improved quickly. Therefore, minimal presurgical orthodontics followed by surgery was performed to correct his facial esthetics and malocclusion.

TREATMENT PROGRESS

The treatment comprised 3 phases. The initial phase involved relieving the postsurgical occlusal interference with a minimal preparation time of 0 to 6 months. When simulating the final postoperative occlusion on the study casts, major fulcrums could be detected around the extruded maxillary right and left first premolars (Fig 4), which made the occlusion unstable. Two self-tapping miniscrews (1.5 × 7 mm; Zhong Bang, Xi'an, China) were placed between the roots of the maxillary first and second premolars on the labial side, and another two (1.5 × 9 mm) were implanted on the palatal side to effectively intrude the maxillary right and left first premolars. Preadjusted 0.022-in MBT (3M Unitek, Monrovia, Calif) brackets were bonded to all teeth, with initial 0.016-in nickel-titanium archwires in both arches. Intruding forces on the maxillary right and left first premolars were loaded immediately after the procedure (Fig 5).

After only 4 weeks, the maxillary right and left first premolars were intruded, and their occlusal interferences vanished dramatically; then the patient was referred to a surgeon (Figs 6-8). According to the visual treatment objective and model surgery, the surgery plan was designed and involved a LeFort I osteotomy, bilateral sagittal split ramus osteotomy, and genioplasty. The maxilla was advanced by 5 mm and drifted to the left by 1 mm, the mandible was moved back by 6 mm on the left and 7 mm on the right, and pogonion was

Table II. Comparison of treatment alternatives

	Advantages	*Disadvantages*
Camouflage treatment	1. To correct the dental anteroposterior discrepancy 2. To avoid a surgical insult 3. To decrease treatment risk and cost	1. No positive effect on esthetic and psychosocial well-being 2. Unstable outcome for a severe skeletal malocclusion
Routinely combined surgical and orthodontic treatment	1. To significantly change the facial appearance and malocclusion 2. To establish a stable occlusion after the operation	1. Progressive deterioration of facial appearance and oral function during presurgical orthodontics 2. Negative effect on psychosocial well-being
Surgery-first approach	1. To obtain a major improvement in the profile at the beginning 2. To eliminate an exaggerated anterior crossbite by incisor decompensation 3. To perform postoperative decompensation more effectively and efficiently	1. Difficulty in obtaining a stable occlusion immediately after the operation 2. Difficulty in predicting the postsurgical results
Minimal presurgical orthodontics	1. To correct a skeletal discrepancy at an earlier stage and minimize deterioration of facial profile 2. To eliminate obvious occlusal interferences, decrease postsurgical instability and unpredictability 3. To perform postsurgical decompensation more effectively and efficiently	1. Dependence on experienced and skilled surgeons and orthodontists

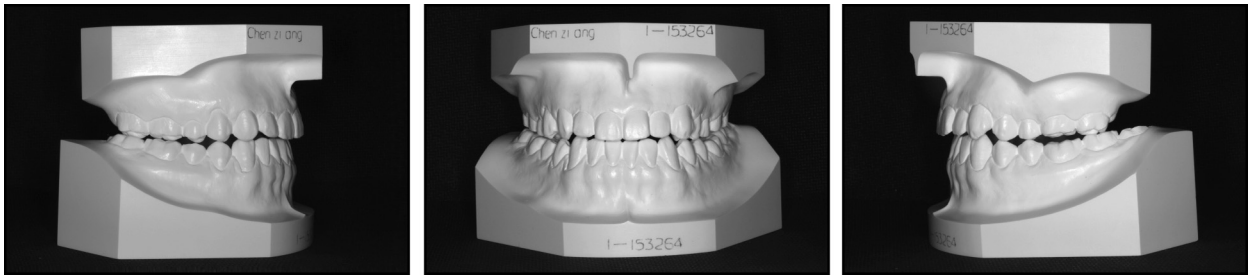

Fig 4. Study casts simulating postsurgical occlusion: occlusal interferences because of extrusion of the maxillary left and right first premolars.

Fig 5. Intraoral photographs after initial treatment.

Fig 6. Presurgical facial and intraoral photographs.

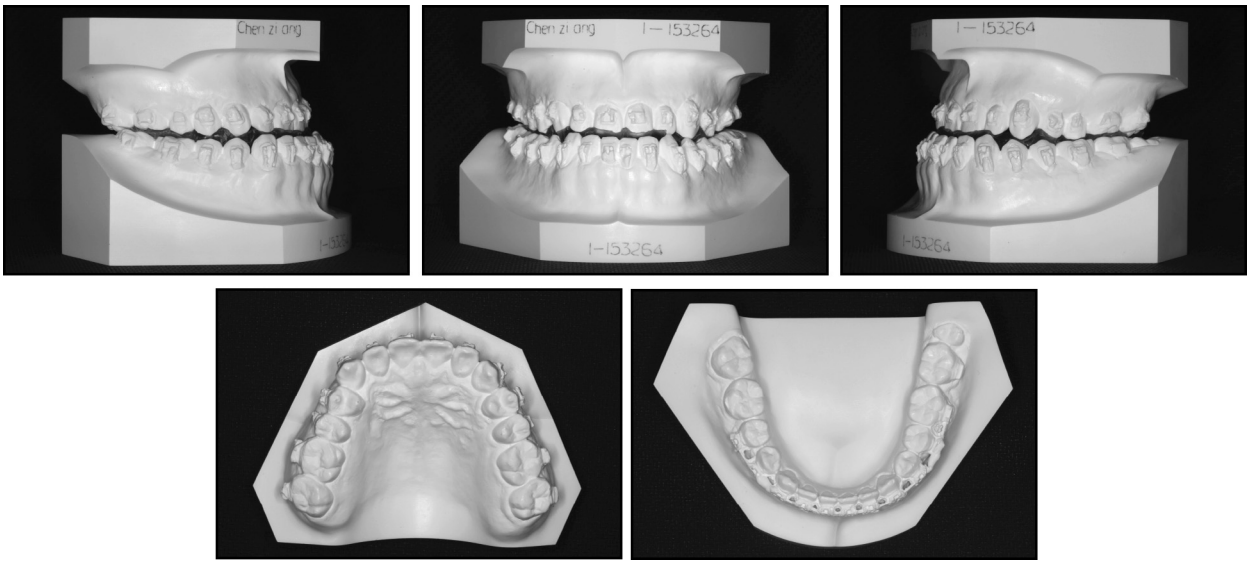

Fig 7. Presurgical study casts.

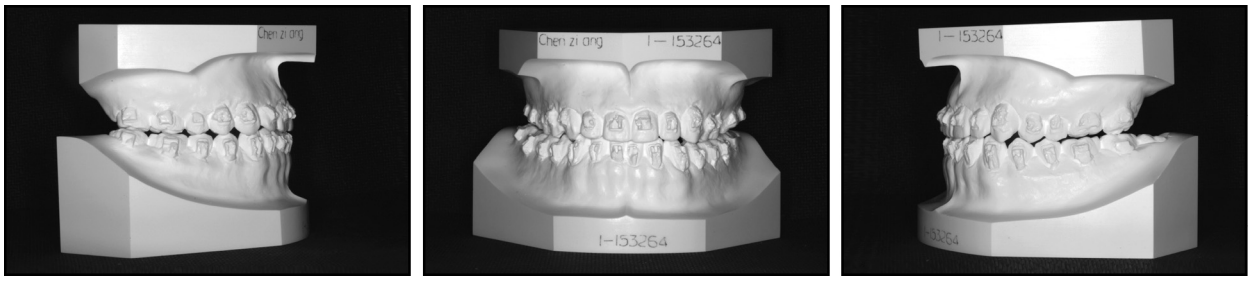

Fig 8. Study casts simulating the postoperative occlusion after intruding the maxillary left and right first premolars: it was more stable than the occlusion in Figure 4.

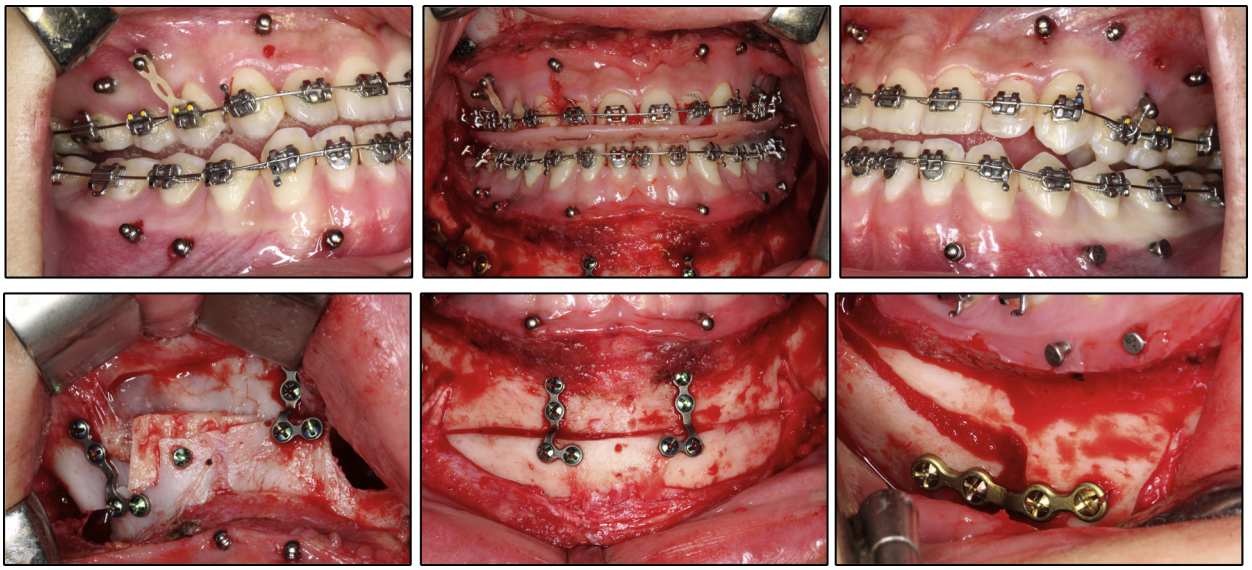

Fig 9. Surgery photographs: miniscrews were placed under general anesthesia to fix both jaws.

advanced by 2 mm. Rigid fixation was used in the maxilla and the mandible (Fig 9). Ten more miniscrews were dispersedly placed interapically in both jaws for the intermaxillary elastics, since the 0.016-in nickel-titanium archwires would be maintained perioperatively (Fig 10).

Four weeks after the operation, the wafer was removed, and the patient was referred back to begin his postsurgery orthodontic treatment (Fig 11). With the aid of intermaxillary fixation between the maxillary and mandibular opposing miniscrews, a relatively stable occlusion was achieved. We inserted 0.016 × 0.022-in nickel-titanium archwires as soon as the patient's voluntary opening was acceptable. After 3 months, the archwires proceeded to 0.019 × 0.025-in nickel-titanium ones (Fig 12). Tie-backs from the second molars to the miniscrews in the mandibular anterior region were used to close the residual spaces created during the decompensation, and the molar relationship changed from Class II to Class I at the same time (Fig 13). We used 0.019 × 0.025-in stainless steel wires for finishing and detailing. All brackets and miniscrews were debonded and removed at month 23, followed by the placement of maxillary and mandibular vacuum-formed retainers (Fig 14).

TREATMENT RESULT

At the end of treatment, esthetic and functional results were achieved. The occlusion was finished with Class I canine and molar relationships. Overbite and overjet were ideal, and the patient's chief complaints of underbite and facial asymmetry were rectified (Fig 15). The maxillary and mandibular dental midlines were coincident with the facial midline. The patient's

Fig 10. Facial and intraoral photographs 2 weeks after surgery: miniscrews were used for intermaxillary fixation.

facial appearance was improved significantly with a straight profile, a symmetrical mandible, and reduced lower facial height. The cephalometric analysis (Table I) and the superimposition show marked improvement in the soft and hard tissues (Figs 16-18). There were no clinical symptoms or radiologic changes to the temporomandibular joint after treatment (Fig 19). The occlusion and esthetics remained intact at 1 year after debonding (Fig 20).

DISCUSSION

Although the classical presurgical orthodontic treatment provides a solid occlusion postsurgically, it increases the anterior crossbite, worsens oral functions and facial esthetics, and consistently creates a negative effect on patients' psychological well-being. Furthermore, orthodontic preparation is a time-consuming progress. Luther et al[6] demonstrated that the average duration of preoperative orthodontic treatment was 17 months with a range of 7 to 47 months.

Nagasaka et al[9] proposed the "surgery-first approach," which involves orthognathic surgery without presurgical orthodontic treatment. After this initial description, more cases and treatment guidelines were published.[15-17] However, the postsurgical occlusion turned out to be typically unstable.[18] Considering the significant role of occlusal stabilization in the prevention of relapse, the indications for the surgery-first approach are limited, and it might increase the risk of postsurgical relapse.

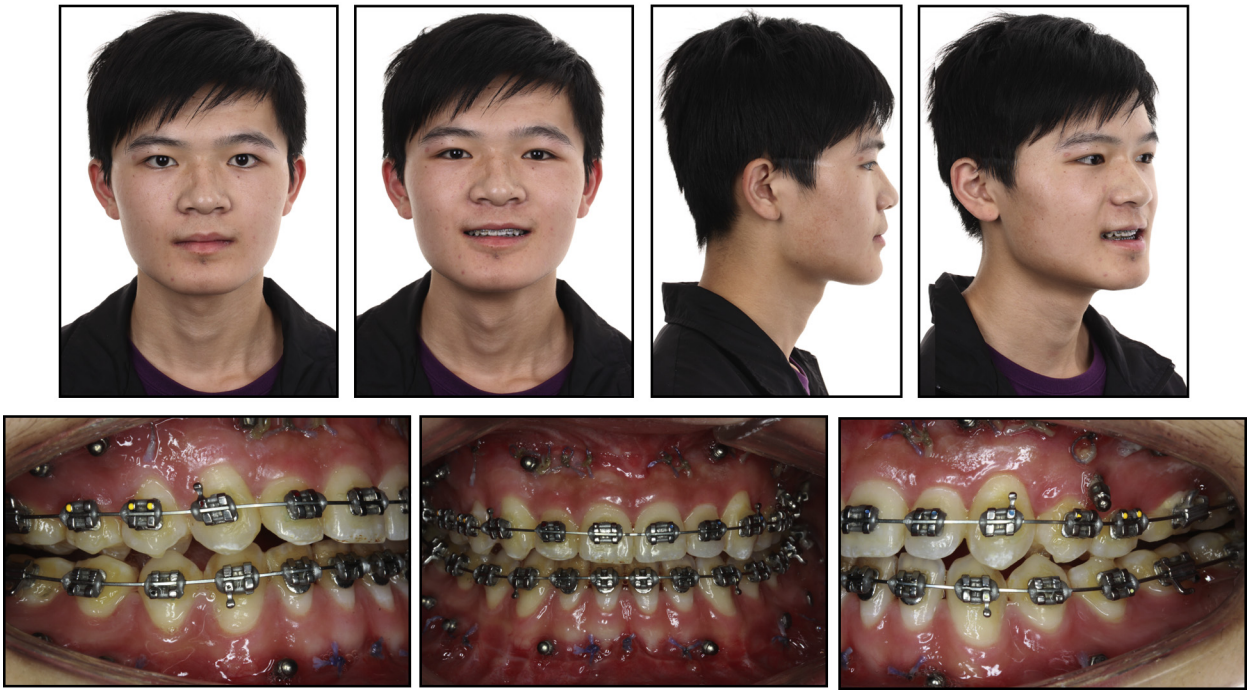

Fig 11. Facial and intraoral photographs 4 weeks after the operation: the wafer was removed, and postsurgical orthodontic treatment started with Class II molar relationships and a deep overjet.

Fig 12. Facial and intraoral photographs after aligning in 3 months.

Fig 13. A miniscrew was used to mesialize the mandibular molars.

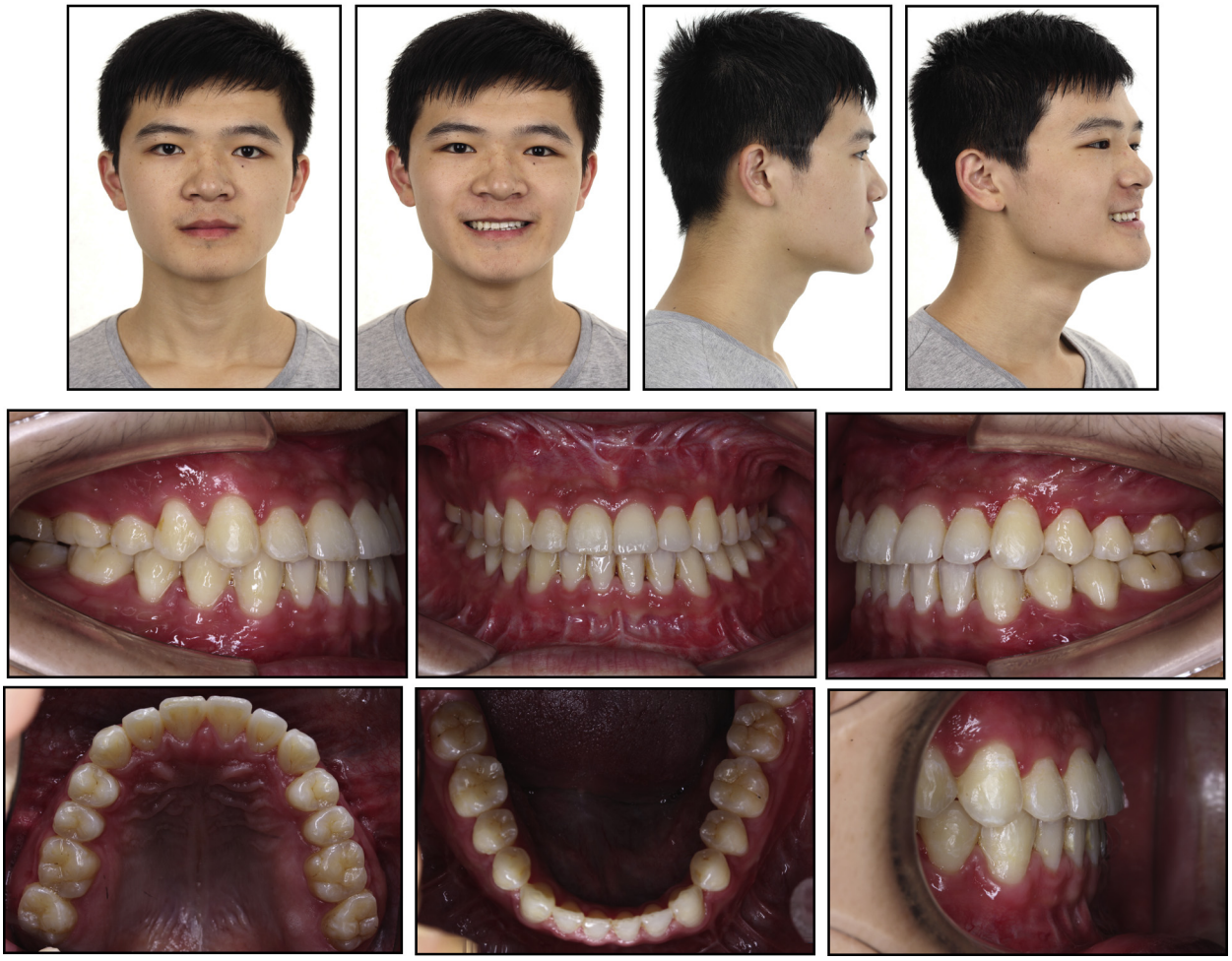

Fig 14. Posttreatment facial and intraoral photographs.

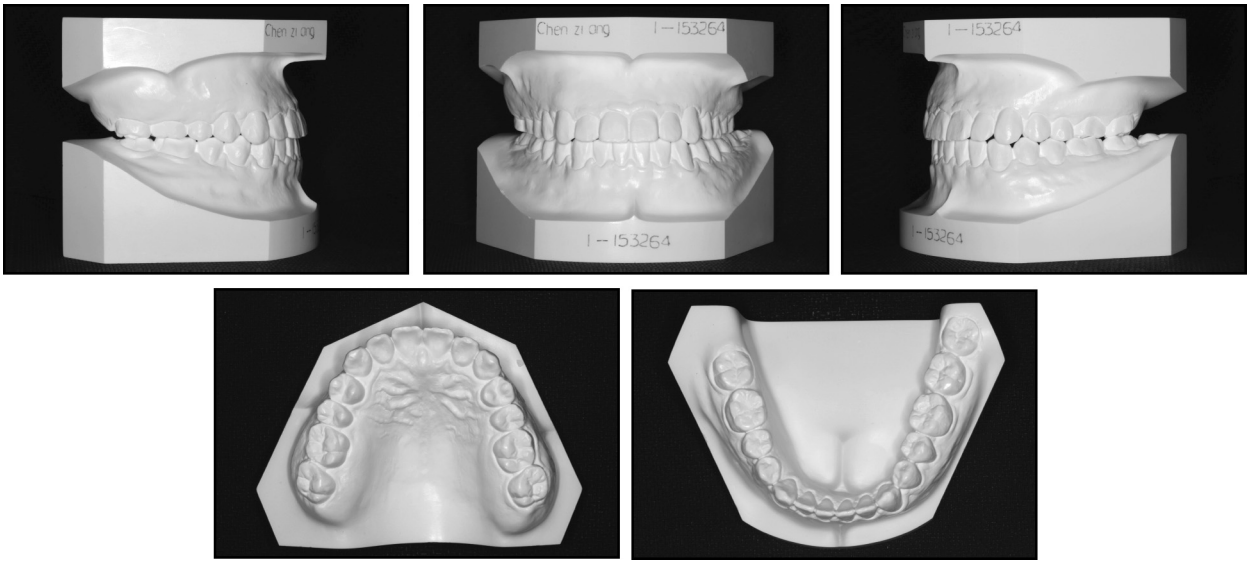

Fig 15. Posttreatment study casts.

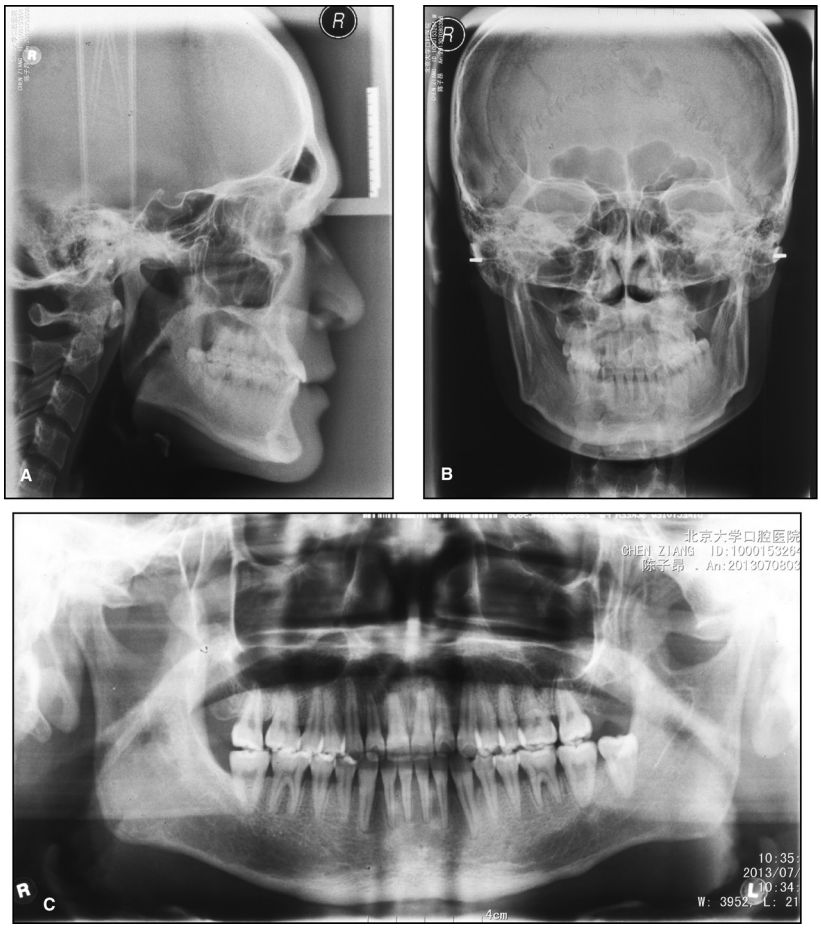

Fig 16. Posttreatment radiographs (titanium plates were removed): **A,** lateral cephalogram; **B,** posteroanterior radiograph; **C,** panoramic radiograph.

There are 3 challenges with these types of patients.

1. We must remove occlusal interferences in a short time—within 6 months—to stabilize the postsurgical occlusion without further deformation of the patient's appearance. Occlusal interferences are often present as extruded maxillary second molars, uncoordinated arches, labially or lingually tipped teeth, and so on. To address these issues efficiently and promptly in the early stage, tools such as surgically assisted rapid maxillary expansion or miniscrews are frequently helpful. For this case, miniscrews were placed on both the labial and palatal sites of the maxillary left and right first premolars, and significant intrusion was observed after only 4 weeks with light and continuous forces.
2. All patients who chose minimal presurgical orthodontics in our clinic had procedures with nickel-titanium wires, which allow postsurgical orthodontic treatment to commence as soon as possible. Since the stiffness of nickel-titanium archwires is relatively too low to bear the intermaxillary fixation force, more miniscrews would be needed between the lateral incisor and canine, the first and second premolars, and the second premolar and first molar in each quadrant.[6] Intermaxillary fixation with miniscrews is highly recommended to maintain the maxillary and mandibular positions before and after wafer removal.
3. With traditional combined orthodontic and surgical procedures, a relatively ideal occlusion can be predicted at the end of presurgical orthodontic treatment.[19] However, for patients needing minimal presurgical treatment, it is much more difficult for the orthodontist to manage the postsurgical tooth movement and to maintain the ideal profile at

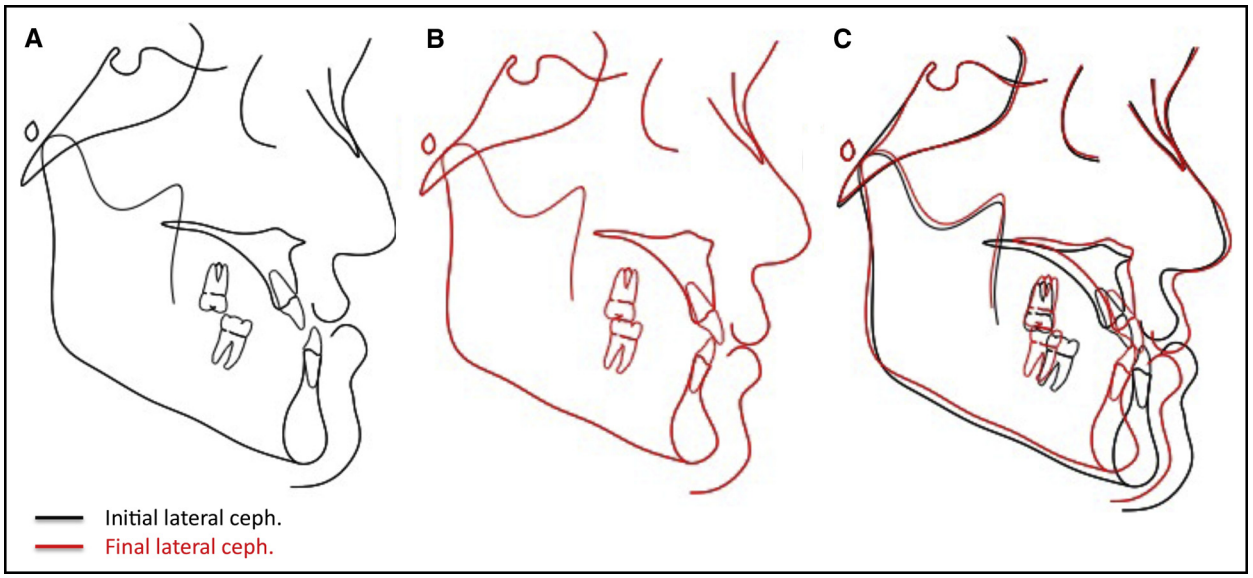

Fig 17. Tracing and superimposition of lateral cephalograms at pretreatment (*black*) and posttreatment (*red*): **A,** initial tracing; **B,** final tracing; **C,** superimposition of **A** and **B**.

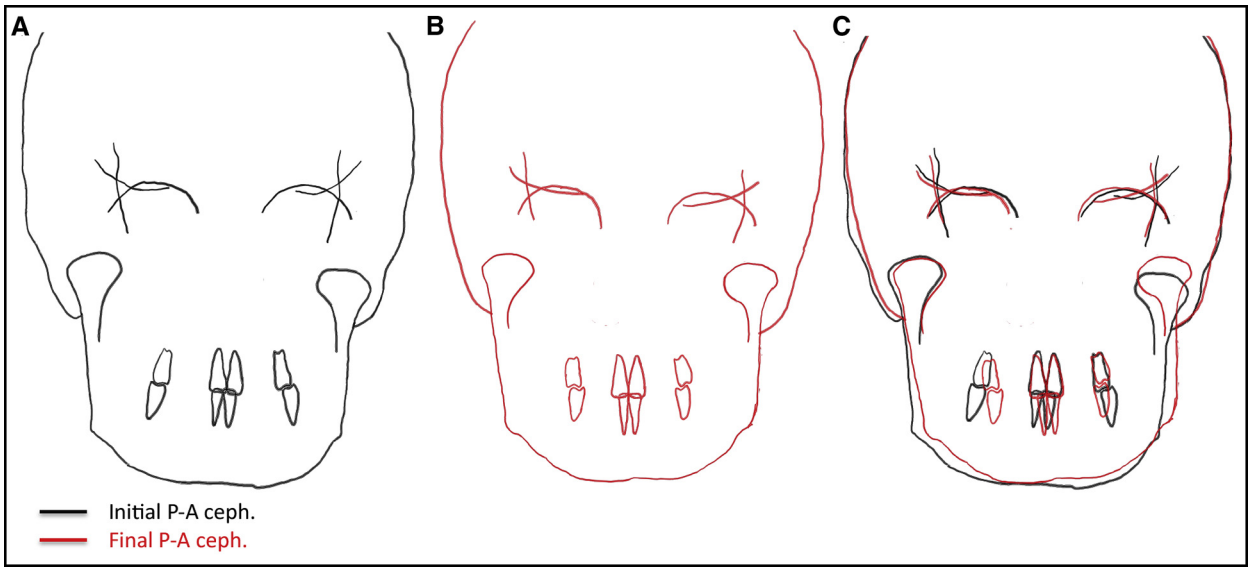

Fig 18. Tracing and superimposition of posteroanterior cephalograms at pretreatment (*black*) and posttreatment (*red*): **A,** initial tracing; **B,** final tracing; **C,** superimposition of **A** and **B**.

almost the same time. After surgery, a large overjet is necessary to provide enough room for anterior decompensation. Class II molar relationships are also required because the mandibular molars should move forward to close the spaces caused by the decompensation of the anterior teeth. Miniscrews, placed during orthognathic surgery, are used as skeletal anchorage and make it easier to hold the anterior teeth and mesialize the mandibular posterior teeth.

After surgery, it took less than 3 months for alignment and leveling in this patient. This supports the

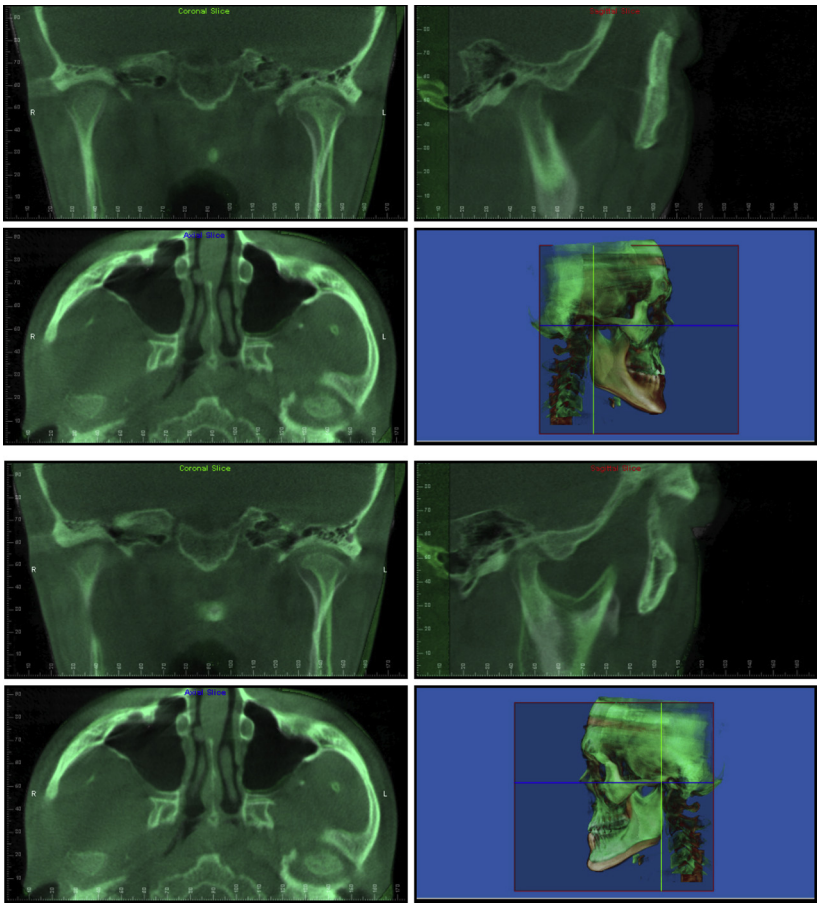

Fig 19. Superimpositions of cone-beam computed tomography images on the cranial base at pretreatment (*white*) and posttreatment (*green*).

assumption of a regional acceleratory phenomenon. After a noxious stimulus, acceleration of most ongoing normal hard and soft tissue processes occurs, including increased bone metabolism, turnover, and modeling.[20] This complex reaction, known as the regional acceleratory phenomenon, initiates the healing process of the injured tissues, resulting in a temporary decrease in regional bone density and an increase in remodeling.[20] Microcomputed tomography analyses showed that surgical insults produce less dense and less mature bone but have no effect on bone volume at 9 weeks after surgery.[21] Additionally, hyalinization of the periodontal ligament appeared to be shorter, and tartrate-resistant acid-phosphatase positive cells tended to work vigorously at an early time.[22] Meanwhile, histologic evaluations indicated demineralization and remineralization in alveolar bone[23]; osteoclasts and osteoblasts increased by local multicellular mediator mechanisms containing precursors, supporting cells, blood capillaries, and lymphatic tissue.[21,22,24,25]

CONCLUSIONS

The success of minimal presurgical orthodontics in treating a patient with a skeletal Class III malocclusion with facial asymmetry was based on minimal but appropriate orthodontic preparation before surgery, constant communication between the orthodontist and the surgeon, and conscientious orthodontic treatment after surgery. In this patient, miniscrews were used multipurposely: ie, to intrude the maxillary first premolars presurgically, fix the intermaxillary relationship during and after surgery, and mesialize the mandibular posterior teeth en masse postoperatively. The patient was satisfied with his appearance and normal oral function.

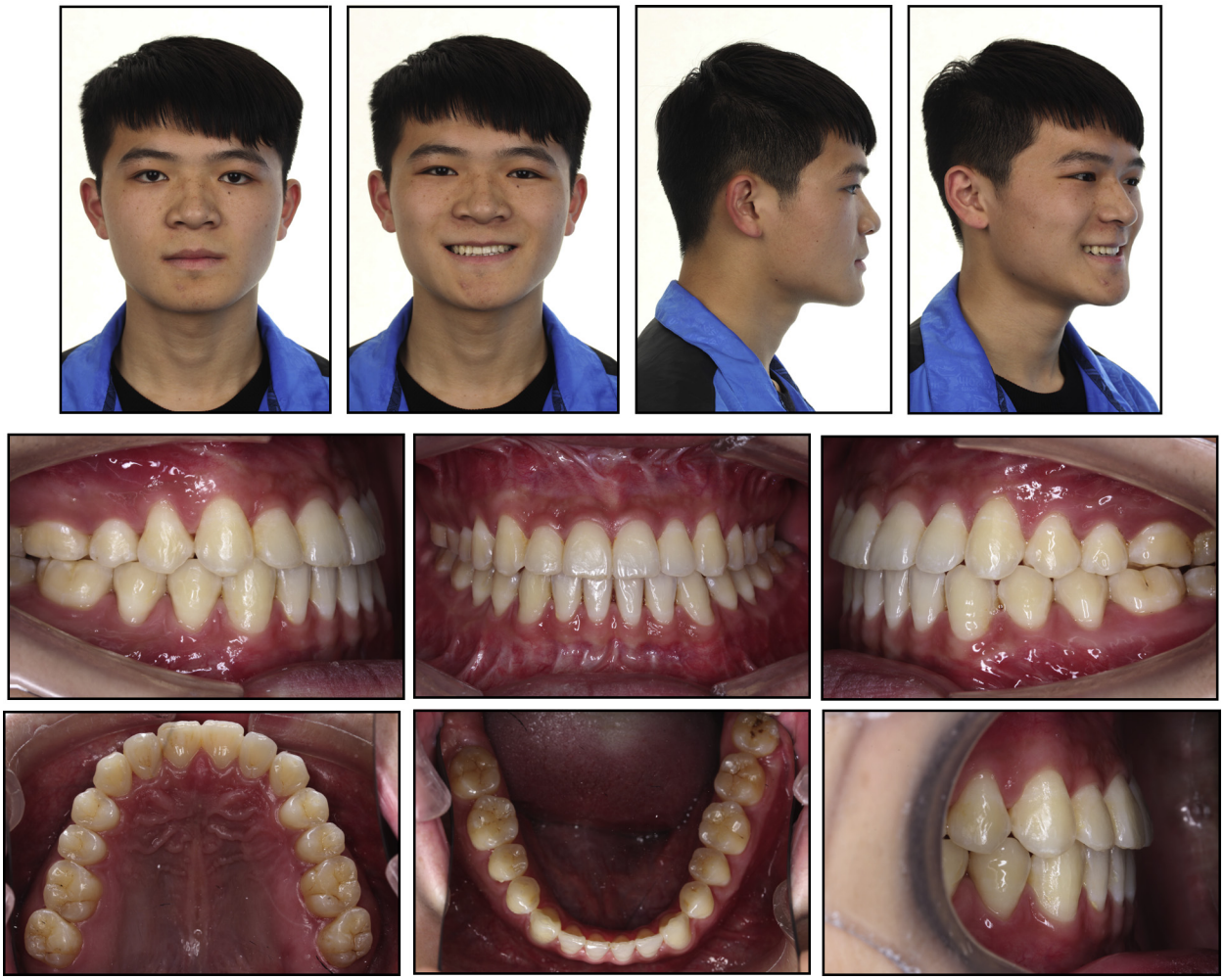

Fig 20. Facial and intraoral photographs 1 year after debonding.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ajodo.2014.10.039.

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